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ATMOSPHERIC CO_2 -- A GLOBAL LIMITING RESOURCE: HOW MUCH FOSSIL CARBON CAN WE BURN?

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ABSTRACT

Carbon dioxide (CO_2) is building up in the atmosphere, largely because of emissions from fossil fuel combustion. An increase in atmospheric CO_2 would enhance Earth's natural greenhouse effect, resulting in an increase in global mean surface temperature (GMST) and other changes in Earth's climate. The increased concentration of CO_2 over the industrial period results in a calculated increase of the global average downwelling thermal infrared irradiance from the atmosphere to the surface (climate "forcing") of well less than 1%. Despite this small change, there is strong theoretical reason to expect that it would give rise to an increase in GMST of magnitude comparable to the temperature increase observed over the past 100 years, and perhaps greater. Studies with global climate models demonstrate that the increase in temperature cannot be accounted for without including in the models the forcing due to increased concentrations of CO_2 and other greenhouse gases, but the small forcing makes it very difficult to accurately calculate the expected increase in GMST, so the sensitivity, the change in GMST per forcing, calculated with such models is uncertain to at least a factor of 2. It is also impossible at present to accurately determine Earth's climate sensitivity empirically from forcing and observed temperature increase, largely because of the confounding influence of atmospheric aerosols. Assumption of specific values of climate sensitivity and choice of a maximum acceptable temperature increase thus place limits on the amount of fossil fuel carbon that can be emitted into the atmosphere. The present lack of knowledge of the climate sensitivity limits effective planning for energy futures.
